1. A synthetic, patterned, longitudinally exchange biased GMR sensor with narrow effective trackwidth and reduced side reading comprising:

a substrate;

a first layer of antiferromagnetic material formed on the substrate, said layer being a pinning layer;

a synthetic antiferromagnetic pinned layer formed on said antiferromagnetic pinning layer;

a non-magnetic spacer layer formed on said pinned layer;

a ferromagnetic free layer formed on said non-magnetic spacer layer, said free layer having a free layer thickness and a free layer magnetic moment M1;

a non-magnetic antiferromagnetically coupling layer formed on said ferromagnetic free layer;

a patterned, ferromagnetic, longitudinal biasing layer formed on said coupling layer, said biasing layer being formed as two discrete, disconnected and laterally separated segments, laterally and symmetrically disposed to either side of the antiferromagnetically coupling layer and wherein the separation of said segments defines a physical trackwidth and wherein said biasing layer has a biasing layer thickness, a biasing layer magnetic moment M2 and wherein there is a synthetic coupling energy J_s between said biasing layer and said free layer and wherein said longitudinal biasing layer is antiferromagnetically coupled to said free layer through said antiferromagnetically coupling layer;

a second antiferromagnetic layer formed on said patterned, longitudinal biasing layer and coexstensive with it, said second antiferromagnetic layer being exchange

coupled to said longitudinal biasing layer and there being an exchange energy, J_{ex}, between said second antiferromagnetic layer and said biasing layer;

a conductive lead layer formed on said antiferromagnetic layer; and wherein said free layer thickness and said biasing layer thickness are determined so that the magnetic moment of said free layer, M_{F1}, and the magnetic moment of said biasing layer, M_{F2}, satisfy the relationship $M_{F2}/M_{F1} =(J_s + J_{ex})/ J_s$.

2. The sensor of claim 1 wherein the first antiferromagnetic layer is a layer chosen from the group of antiferromagnetic materials consisting of PtMn, IrMn, NiMn, PdPtMn and Fe Mn.

3. The sensor of claim 1 wherein the first antiferromagnetic layer is a layer of PtMn and is formed to a thickness of between approximately 50 and 200 angstroms, but is preferably 100 angstroms.

4. The sensor of claim 1 wherein the synthetic antiferromagnetic pinned layer is a trilayer comprising a first and second ferromagnetic layer separated by a non-magnetic antiferromagnetically coupling layer.

5. The sensor of claim 4 wherein the first and second ferromagnetic layers are layers of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

6. The sensor of claim 4 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

7. The sensor of claim 1 wherein the synthetic antiferromagnetic pinned layer is a trilayer comprising a first layer of CoFe, formed to a thickness of between approximately 10 and 30 angstroms with approximately15 angstroms being preferred and a second layer of CoFe formed to a thickness of between approximately 10 and 40 angstroms with approximately 20 angstroms being preferred, with a layer of Ru between them of thickness between approximately 2 and 9 angstroms with approximately 7.5 angstroms being preferred.

8. The sensor of claim 1 wherein the non-magnetic spacer layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

9. The sensor of claim 1 wherein the non-magnetic spacer layer is a layer of Cu formed to a thickness of between approximately 5 and 30 angstroms, with approximately 18 angstroms being preferred.

10. The sensor of claim 1 wherein the ferromagnetic free layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

11. The sensor of claim 1 wherein the ferromagnetic free layer is a bilayer comprising a first ferromagnetic layer on which is formed a second ferromagnetic layer wherein said first ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi and wherein said second ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

12. The sensor of claim 1 wherein the ferromagnetic free layer is a bilayer comprising a layer of CoFe of thickness between approximately 3 and 15 angstroms, where approximately 10 angstroms is preferred, on which is formed a layer of NiFe of thickness between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred.

13. The sensor of claim 1 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

14. The sensor of claim 1 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Ru formed to a thickness of between approximately 2 and 9 angstroms, where approximately 7.5 angstroms is preferred.

15. The sensor of claim 1 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Rh formed to a thickness of between approximately 3 and 6 angstroms, where approximately 5 angstroms is preferred.

16. The sensor of claim 14 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 22 angstroms and 34 angstroms with approximately 28 angstroms being preferred.

17. The sensor of claim 15 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 18.6 angstroms and 26.6 angstroms with approximately 22.6 angstroms being preferred.

18. The sensor of claim 16 wherein the second antiferromagnetic layer is a layer of IrMn formed to a thickness between approximately 25 and 100 angstroms, where approximately 40 angstroms is preferred.

19. The sensor of claim 17 wherein the second antiferromagnetic layer is a layer of IrMn formed to a thickness between approximately 25 and 100 angstroms, where approximately 40 angstroms is preferred.

20. The sensor of claim 1 wherein the values of M_{F1}, M_{F2}, J_s and J_{ex} are determined by coherent rotation simulation.

21. The sensor of claim 1 wherein the values of M_{F1}, M_{F2}, J_s and J_{ex} are determined by experiment.

22. A synthetic, patterned, longitudinally exchange biased GMR sensor with narrow effective trackwidth and reduced side reading comprising:

a substrate;

a first layer of antiferromagnetic material formed on the substrate, said layer being a pinning layer;

a synthetic antiferromagnetic pinned layer formed on said antiferromagnetic pinning layer;

a non-magnetic spacer layer formed on said pinned layer;

a ferromagnetic free layer formed on said non-magnetic spacer layer, said free layer having a free layer thickness and a free layer magnetic moment M1;

a non-magnetic antiferromagnetically coupling layer formed on said ferromagnetic free layer;

a patterned, ferromagnetic, longitudinal biasing layer formed on said coupling layer, said biasing layer being formed as two discrete, disconnected and laterally separated segments, laterally and symmetrically disposed to either side of the antiferromagnetically coupling layer and wherein the separation of said segments defines a physical trackwidth and wherein said biasing layer has a biasing layer thickness, a biasing layer magnetic moment M2 and wherein there is a synthetic coupling energy J_s between said biasing layer and said free layer and wherein said longitudinal biasing layer

is antiferromagnetically coupled to said free layer through said antiferromagnetically coupling layer;

a conductive lead layer formed on said ferromagnetic biasing layer; and wherein said free layer thickness and said biasing layer thickness are determined so that the magnetic moment of said free layer, M_{F1}, and the magnetic moment of said biasing layer, M_{F2}, satisfy the relationship $M_{F2}/M_{F1} = 1$.

23. The sensor of claim 21 wherein the antiferromagnetic layer is a layer chosen from the group of antiferromagnetic materials consisting of PtMn, IrMn, NiMn, PdPtMn and Fe Mn.

24. The sensor of claim 21 wherein the antiferromagnetic layer is a layer of PtMn and is formed to a thickness of between approximately 50 and 200 angstroms, but is preferably approximately 100 angstroms.

25. The sensor of claim 21 wherein the synthetic antiferromagnetic pinned layer is a trilayer comprising a first and second ferromagnetic layer separated by a non-magnetic antiferromagnetically coupling layer.

26. The sensor of claim 25 wherein the first and second ferromagnetic layers are layers of ferromagnetic material chosen from the group consisting of CoFe, NiFe-------.

27. The sensor of claim 25 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

28. The sensor of claim 22 wherein the synthetic antiferromagnetic pinned layer is a trilayer comprising a first layer of CoFe, formed to a thickness of between approximately 10 and 30 angstroms with approximately15 angstroms being preferred and a second layer of CoFe formed to a thickness of between approximately 10 and 40 angstroms with 20 angstroms being preferred, with a layer of Ru between them of thickness between approximately 2 and 9 angstroms with 7.5 angstroms being preferred.

29. The sensor of claim 22 wherein the non-magnetic spacer layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

30. The sensor of claim 22 wherein the non-magnetic spacer layer is a layer of Cu formed to a thickness of between approximately 5 and 30 angstroms, with approximately 18 angstroms being preferred.

31. The sensor of claim 22 wherein the ferromagnetic free layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

32. The sensor of claim 22 wherein the ferromagnetic free layer is a bilayer comprising a first ferromagnetic layer on which is formed a second ferromagnetic layer

wherein said first ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi and wherein said second ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

33. The sensor of claim 22 wherein the ferromagnetic free layer is a bilayer comprising a layer of CoFe of thickness between approximately a and 15 angstroms, where approximately 10 angstroms is preferred, on which is formed a layer of NiFe of thickness between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred.

34. The sensor of claim 22 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

35. The sensor of claim 22 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Ru formed to a thickness of between approximately 2 and 9 angstroms, where approximately 7.5 angstroms is preferred.

36. The sensor of claim 22 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Rh formed to a thickness of between approximately 3 and 6 angstroms, where approximately 5 angstroms is preferred.

37. The sensor of claim 35 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 22 angstroms and 34 angstroms with 28 angstroms being preferred.

38. The sensor of claim 36 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 18.6 angstroms and 26.6 angstroms with 22.6 angstroms being preferred.

39. The sensor of claim 34 wherein the biasing layer is a synthetic structure comprising a first ferromagnetic layer and a second ferromagnetic layer between which is a non-magnetic coupling layer.

40. The sensor of claim 39 wherein the first ferromagnetic layer is a layer of CoFe formed to a thickness of between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred, the second ferromagnetic layer is a layer of CoFe formed to a thickness of between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred and where the coupling layer is a layer of Ru formed to a thickness of between approximately 2 and 9 angstroms with approximately 7.5 angstroms being preferred.

41. The sensor of claim 22 wherein the values of M_{F1}, M_{F2} and J_s are determined by coherent rotation simulation.

42. The sensor of claim 1 wherein the values of M_{F1}, M_{F2} and J_s are determined by experiment.

43. The sensor of claim 1 wherein the physical trackwidth is less than approximately 0.2 microns.

44. The sensor of claim 22 wherein the physical trackwidth is less than approximately 0.2 microns.

45. A method for fabricating a synthetic, patterned, longitudinally exchange biased GMR sensor with narrow effective trackwidth comprising:

providing a substrate;

forming a seed layer on said substrate;

forming a first layer of antiferromagnetic material on the seed layer, said layer of antiferromagnetic material being a pinning layer;

forming a synthetic antiferromagnetic pinned layer on said first antiferromagnetic pinning layer;

forming a non-magnetic spacer layer on said pinned layer;

forming a ferromagnetic free layer of thickness F1 and magnetic moment M_{F1} on said non-magnetic spacer layer;

forming a non-magnetic antiferromagnetically coupling layer on said ferromagnetic free layer;

forming a ferromagnetic, longitudinal biasing layer of thickness F2, and magnetic moment M_{F2} on said coupling layer, producing thereby a coupling energy J_s and an exchange energy J_{ex}, and wherein the thicknesses F1 and F2 will be determined so that a ratio of the respective magnetic moments M_{F2}/M_{F1} satisfy a relationship

$M_{F2}/M_{F1} = (J_s + J_{ex})/J_s$;

forming a second antiferromagnetic pinning layer on said longitudinal biasing layer;

forming a conductive lead layer on said antiferromagnetic layer;

annealing the resulting structure with a first anneal for a first annealing time, at a first annealing temperature and in a first external magnetic field;

annealing the resulting structure with a second anneal for a second annealing time, at a second annealing temperature and in a second external magnetic field;

removing, by an etching process, a central portion of said conductive lead layer and the portion of said second antiferromagnetic pinning layer directly beneath said central portion, exposing, thereby, an upper surface of said longitudinal biasing layer beneath said pinning layer and forming, thereby, two discrete, disconnected and laterally separated segments, laterally and symmetrically disposed to either side of said longitudinal biasing layer and separated by the desired physical trackwidth of said sensor;

oxidizing the exposed portion of said ferromagnetic longitudinal biasing layer, said oxidation extending the entire width and thickness of said exposed portion and destroying the ferromagnetic properties of said layer and said oxidation being stopped by the upper surface of said non-magnetic antiferromagnetically coupling layer.

46. The method of claim 45 wherein the ferromagnetic free layer is a bilayer comprising a first ferromagnetic layer on which is formed a second ferromagnetic layer wherein said first ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi and wherein said second ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

47. The method of claim 45 wherein the ferromagnetic free layer is a bilayer comprising a layer of CoFe of thickness between approximately 3 and 15 angstroms, where approximately 10 angstroms is preferred, on which is formed a layer of NiFe of thickness between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred.

48. The method of claim 45 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

49. The method of claim 45 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Ru formed to a thickness of between approximately 2 and 9 angstroms, where approximately 7.5 angstroms is preferred.

50. The method of claim 45 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Rh formed to a thickness of between approximately 3 and 6 angstroms, where approximately 5 angstroms is preferred.

51. The method of claim 49 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 22 angstroms and 34 angstroms with approximately 28 angstroms being preferred.

52. The method of claim 50 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 18.6 angstroms and 26.6 angstroms with approximately 22.6 angstroms being preferred.

53. The method of claim 51 wherein the second antiferromagnetic layer is a layer of IrMn formed to a thickness between approximately 25 and 100 angstroms, where approximately 40 angstroms is preferred.

54. The method of claim 52 wherein the second antiferromagnetic layer is a layer of IrMn formed to a thickness between approximately 25 and 100 angstroms, where approximately 40 angstroms is preferred.

55. The method of claim 45 wherein the values of M_{F1}, M_{F2}, J_s and J_{ex} are determined by coherent rotation simulation.

56. The method of claim 45 wherein the values of M_{F1}, M_{F2}, J_s and J_{ex} are determined by experiment.

57. A method for fabricating a synthetic, patterned, longitudinally exchange biased GMR sensor with narrow effective trackwidth comprising:

providing a substrate;

forming a seed layer on said substrate;

forming a first layer of antiferromagnetic material on the seed layer, said layer of antiferromagnetic material being a pinning layer;

forming a synthetic antiferromagnetic pinned layer on said first antiferromagnetic pinning layer;

forming a non-magnetic spacer layer on said pinned layer;

forming a ferromagnetic free layer of thickness F1 and magnetic moment M_{F1} on said non-magnetic spacer layer;

forming a non-magnetic antiferromagnetically coupling layer on said ferromagnetic free layer;

forming a ferromagnetic, longitudinal biasing layer of thickness F2, and magnetic moment M_{F2} on said coupling layer, producing thereby a coupling energy J_s, and wherein the thicknesses F1 and F2 will be determined so that a ratio of the respective magnetic moments M_{F2}/M_{F1} satisfy a relationship $M_{F2}/M_{F1}=1$;

forming a conductive lead layer on said longitudinal biasing layer;

annealing the resulting structure with a first anneal for a first annealing time, at a first annealing temperature and in a first external magnetic field;

annealing the resulting structure with a second anneal for a second annealing time, at a second annealing temperature and in a second external magnetic field;

removing, by an etching process, a central portion of said conductive lead layer, exposing, thereby, an upper surface of said longitudinal biasing layer beneath said pinning layer and forming, thereby, two discrete, disconnected and laterally separated segments, laterally and symmetrically disposed to either side of said longitudinal biasing layer and separated by the desired physical trackwidth of said sensor;

oxidizing the exposed portion of said ferromagnetic longitudinal biasing layer, said oxidation extending the entire width and thickness of said exposed portion and destroying the ferromagnetic properties of said layer and said oxidation being stopped by the upper surface of said non-magnetic antiferromagnetically coupling layer.

58. The method of claim 57 wherein the ferromagnetic free layer is a bilayer comprising a first ferromagnetic layer on which is formed a second ferromagnetic layer wherein said first ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi and wherein said second ferromagnetic layer is a layer of ferromagnetic material chosen from the group consisting of CoFe, NiFe and CoFeNi.

59. The method of claim 57 wherein the ferromagnetic free layer is a bilayer comprising a layer of CoFe of thickness between approximately 3 and 15 angstroms, where approximately 10 angstroms is preferred, on which is formed a layer of NiFe of

thickness between approximately 10 and 40 angstroms, where approximately 20 angstroms is preferred.

60. The method of claim 57 wherein the non-magnetic antiferromagnetically coupling layer is a layer of non-magnetic material chosen from the group consisting of Cu, Ru and Rh.

61. The method of claim 57 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Ru formed to a thickness of between approximately 2 and 9 angstroms, where approximately 7.5 angstroms is preferred.

62. The method of claim 57 wherein the non-magnetic antiferromagnetically coupling layer is a layer of Rh formed to a thickness of between approximately 3 and 6 angstroms, where approximately 5 angstroms is preferred.

63. The method of claim 61 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 22 angstroms and 34 angstroms with approximately 28 angstroms being preferred.

64. The method of claim 62 wherein the ferromagnetic biasing layer is a layer of CoFe formed to a thickness between approximately 18.6 angstroms and 26.6 angstroms with approximately 22.6 angstroms being preferred.